visible at some distance, and they are white or black, to be used according to circumstances; moreover, the signalmen are furnished both with binoculars and telescopes to enable them to read the signals from remote stations. At night either a bright colza light is made use of, or a spirit flame, into which is blown from to time a mixture of powdered magnesium and resin. A short puff or a long puff constitutes short and long signals, which are displayed, as before, in accordance to the Morse code. Every battalion of infantry and regiment of cavalry in the British army has a proportion of its men trained as signallers, so that these can act at once on taking the field. Their duty is to communicate between outlying pickets and the fighting column, and to do duty where there is no telegraph. For let the field telegraph of an army be ever so well ordered, there is always plenty to do for the army signaller; and he will doubtless find in the heliostat a means of fulfilling these duties with increased efficiency. H. BADEN PRITCHARD

FLOODING THE SAHARA

THE French scheme of turning part of the Algerian Sahara into an inland sea continues to attract considerable attention in France, and scarcely a week passes without some allusion being made to it in the Paris Academy. At a recent sitting M. de Lesseps read a letter from Capt. Roudaire in which the latter gave some details of the results of his sounding of the soil at various points, sands and marls being the beds most commonly met with. At one place, four metres below the surface, plenty of potable water was met with, which will be a great saving in carrying on the work.

At the same sitting MM. Ch. Martens and Ed. Desor presented several considerations against carrying out the plan, their opposition to it being shared by several other French men of science. They have themselves examined part of the ground which it is proposed to put under water, so that their opinions ought to have some weight. While giving every credit to M. Roudaire for the accuracy of the survey which he is carrying out, they, however, point out the difficulty of perfect accuracy, which in this case is all important, in the classic country of mirage, where the surface of the ground is constantly altered and deformed by reflection and refraction. Moreover, they point out that to the south of the projected sea is the Wed-Souf, where are ripened the dates known as Tunis dates, the culture of which is a very special one. The least error in surveying, it is shown, might lead to the destruction of this culture, by allowing the waters of the Mediterranean to penetrate the soil where the date-trees are grown, and thus destroy them. The authors do not attempt to touch the argument that even in historical times part of the Sahara now being surveyed was really a great lake; but they point out that there are proofs that in prehistoric times there must have existed an interior sea, at an epoch when the hydrographical conditions of Europe were very different from what they are now. In 1863, when exploring the region between the oases of Guemar and the south extremity of the Shott Mebrir, they found the gypsum beds of the plateaux ended in regular lines like sedimentary beds, and from the soil they collected the *débris* of shells, truly marine, such as *Buccinum giberrulum*, Lam., and *Balanus miser*, L. Above these shells, in the sand, they found *Cardium edule*, better preserved than they had ever seen it. Thus they found fossils characteristic of salt water, and of those which are a mixture of salt and sweet. The retirement of the waters from the Sahara the authors attribute to the elevation of the land, which is even yet below the level of the Mediterranean, and is to a great extent a network of salt lagoons.

It has been said that the creation of an interior sea, of 13,280 square kilometres, would change the pluviometric condition of the country, and even that of the whole of Algeria. This MM. Martens and Desor regard as a great illusion. Although the laws of the general atmospherical movements are little known, yet it is admitted that the Atlantic is the great reservoir from which come the vapours which are resolved into rain over the European continent. They believe that this is also the case for Africa. The Mediterranean is really only a Gulf of the Atlantic, and they do not believe that an addition of 13,000 kilometres will add anything to its climatic influence. Long calculations have been made as to the quantity of water that would be evaporated by the new sea; but the authors point out that the predominating wind in the region is north, and that if it were rendered either too cold or too moist it would injuriously affect the date-culture carried on in the south. The surroundings of interior seas, like the Caspian and Aral, are steppes noted for their aridity; the shores of the Mediterranean suffer in the same way when, as last year, the rains of the north do not extend to the south. For these reasons MM. Martens and Desor think it would be a mistake to insist on the creation of the interior Saharan Sea.

In a subsequent sitting, however, it should be said, M. Favé endeavoured to show that their fears were groundless, especially with regard to the accuracy of the survey; he thinks that the work in connection with the Suez Canal showed that perfect confidence may be placed in the methods of surveying adopted.

THE LONGEST TUNNEL IN THE WORLD

SCHEMNITZ, the principal mining city of Hungary, has celebrated the opening of the Joseph II. Mining Adit, the deepest gallery of efflux of that place, and the longest subterranean work of this kind in the world.

Its excavation was commenced in the year 1782, during the reign of the Emperor Joseph II., whose name it bears, and has been continued since that time, but with varied energy. The most rapid progress was made within the last five years, so that its completion on September 5th, 1878, was a kind of surprise, and was saluted by guns, which caused a great joy in the city, because it announced a new era for the mining operations of the whole district.

Works of such importance deserve to be installed with solemnity, and a festival was arranged for the purpose on October 20-22, 1878. Prof. Szabó, one of the guests from Budapest, delivered a report to the Royal Hungarian Society of Naturalists, as a representative of that body, and we shall not hesitate to communicate an extract of this.

As the mining operations were progressing in depth, there was at the same time a well regulated system of sinking shafts and driving tunnels employed. The Joseph II. Adit is the eleventh of that kind; it lies 200 metres deeper than the Francis Adit, which was until now the principal gallery of efflux for the mines of Schemnitz. This was excavated between the years 1494 and 1637 to a length of 1,968 metres; but a greater extension was given to it by continuing the works from 1747 till 1765. After this period the mines of Schemnitz proved to be so lucrative, that the idea of undertaking some greater work for securing the future prosperity of the mines was conceived, and so the plan was fixed of driving a tunnel at the deepest possible level, which could convey the waters to the valley of Gran, the lowest point indeed which could be obtained within a practicable distance.

They commenced boring the tunnel west from Schemnitz, near the village of Voznitz, on the left bank of the Gran. The height of it is three metres, the width 1·6 metres. About the lower third is destined to convey off the waters, while the upper two-thirds are separated from this by a platform, and adapted for transporting the ores.

According to the original plan it could have been finished in thirty years at the cost of 1,215,000 florins.

The cost per metre would thus have been 87fl. 86kr., and indeed such was the case in the first eleven years; but after the French revolution the value of money was greatly changed, and the prices became so high, that in the next thirty-three years very little was done, the yearly progress not being more than 61·4 metres, and the cost per metre 371fl. 52kr.

From 1826 the works were carried on with greater energy at the cost of 260fl. 40kr. per metre till 1835, when the progress again became slow, and remained so for the next eighteen years, only seventy-two metres being worked yearly, at the cost of 313fl. 45kr. per metre.

But after the middle of the present century the sense of the decline of the mines from their former state of prosperity was so prevalent, that the director of the district, M. Russegger, well known on account of his scientific travels in Europe, Asia, and Africa, proposed that they should again devote greater energy to the works in question, as most of the mines were under water, and the raising of this by machines caused an outlay which the mines were not able to bear. For the next twelve years the yearly progress was 293·2 metres, at the cost of 237fl. 63kr. per metre. During the next five years after Russegger's time only 141·1 metres were worked out yearly.

The Hungarian government has through the last ten years again developed greater activity in this work, and the parliament has at its request granted the yearly sum of 100,000 florins for the purpose.

In the year 1874 there were still 2,326 metres to be worked out, which would under ordinary circumstances have been a task of eleven years; but in 1873 experiments were made in boring with machines, which method was tried for the first time in the Mont Cenis tunnel, with surprising success, then in the St. Gothard railway tunnel, and lastly in the "Sutro" gallery (Nevada). After many trials they succeeded in finding out the most convenient arrangement, and the whole work was done in three and a half years. With this method the entire tunnel could have been finished in 27 years.

The length of the Mont Cenis tunnel is ... 12,233 metres.
" " St. Gothard is ... ... 14,920 metres.
" " Sutro gallery of mines is 6,147 metres.
" " Joseph II. Adit is ... 16,538 metres.

The total cost amounts to 4,599,000 florins.

The importance of this tunnel is very great, firstly as regards *geology*. The geological and orographical literature of that country is very old; Schemnitz has been repeatedly visited by distinguished men of science from all quarters of Europe, but the difficulties and complications of its geological structure are so great that there is still much to be done. One of the greatest obstacles in the way of investigation is that the surface is very seldom well exposed; dense forests and products of decomposition of the rocks cover many of the slopes. The tunnel furnishes a section more than ten miles in length, and gives not only valuable information as to the downward prolongation of the lodes known in the upper levels, but some new ones have been traversed, and the entire series of rocks, with their mutual limits as well as modifications and occasional transitions is to be seen without interruption.

It is important secondly as regards *mining*. A new region has been made accessible, and the master-lodes can now be worked to their full extent, while in past years all activity was absorbed by the unlucrative Adit itself. Now the works again promise a long continuance. All the machines used in raising the waters are put away, and thence an outlay of more than 100,000 florins is saved yearly.

The last and not least advantage consists in enriching the miner with new means of working. The application of mechanical boring may be considered as forming for him a new era, just as did the introduction of gunpowder; he will now much more easily undertake the driving of adit-levels, whenever this is feasible, and so, it is to be hoped, that the neighbouring old mining cities will successively have their galleries of efflux too, which is the essential condition of the restoration of their prosperity in mining.

OUR ASTRONOMICAL COLUMN

BRORSEN'S COMET.—From an observation at Kremsmunster by Prof. Strasser on March 14, it appears that this comet has passed its perihelion several hours later than the time calculated by Dr. Schulze of Dobeln, the corrections to the ephemeris on that date being − 31s. in right ascension and − 3″·5 in declination; yet observations at Rome on February 17 and at Arcetri, Florence, on March 10, give different corrections. For the present, as the ephemeris is sufficiently near for finding the comet, the following positions and distances may be extracted from it :—

0h. Berlin M.T.	Right Ascension. h. m. s.	Declination North. ° ′	Log. distance from Earth.	Log. distance from Sun.
April 4 ...	2 55 29 ...	25 44 ...	9·9789 ...	9·7767
,, 5 ...	2 59 16 ...	26 59		
,, 6 ...	3 3 5 ...	28 15 ...	9·9663 ...	9·7824
,, 7 ...	3 6 58 ...	29 32		
,, 8 ...	3 10 55 ...	30 49 ...	9·9538 ...	9·7898
,, 9 ...	3 14 56 ...	32 7		
,, 10 ...	3 19 2 ...	33 25 ...	9·9415 ...	9·7986
,, 11 ...	3 23 13 ...	34 44		
,, 12 ...	3 27 31 ...	36 2 ...	9·9295 ...	9·8086
,, 13 ...	3 31 58 ...	37 22		
,, 14 ...	3 36 32 ...	38 41 ...	9·9179 ...	9·8196

On March 10 Dr. Tempel estimated the comet brighter than a star of the eighth magnitude, the theoretical intensity of light at the time being 1·18; the maximum value attained this year is 3·33 on April 14, and during the latter half of April and the whole of May the comet will no doubt be well observed; from April 14 to June 10 it will be constantly above the horizon of Greenwich. At its next return in 1884, its apparent track in the heavens is not likely to be a favourable one for observation, and as long a course of observation as is practicable at the present appearance will be desirable for carrying forward the elements of the orbit to 1890.

MIRA CETI.—In 1879 and 1880 the minima of this variable occur at times when the star will be too near the sun to be observable, but the maxima, according to Argelander's formula of sines, take place under very favourable circumstances for accurate determination, in 1879 on September 11, and in 1880 on August 11. From the observations of Dr. Julius Schmidt at Athens, it appears that this formula, which had given the epochs of maximum in 1876 and 1877 (two) earlier than the observed times by 17·7, 16·8, and 19·4 days respectively, was only in error in this direction four days in 1878.

Among variable stars now favourably situated for observation, may be mentioned Lalande 23617 and 23726, the former has been rated from 6m. to 9m., and the latter from 5m. to 8m. Also Lalande 26211, which has been noted as high as 6m. and as low as 9m.; the variation, however, appears less decided in this case, though Bessel estimated the star 8m.; Lalande's 9m. may perhaps be considered a misprint, as there are known to be similar cases in the "Histoire Céleste."

THE MINOR PLANET HILDA.—A new determination of the orbit of this, the most distant member of the minor planet group, by Kühnert, of Vienna, assigns a period of revolution of 2,861 days, or 7·832 years, and an aphelion distance of 4·52; at this point of its orbit the planet is distant from the orbit of Jupiter only 0·85, so that considerable perturbations are possible. The search for Hilda at the present opposition, so far as we know, has been unsuccessful.